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Exploration of Factors Affecting Success of Undergraduate Engineering Majors at a Historically Black University

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by
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Approval Page

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Abstract

Exploration of Factors Affecting Success of Undergraduate Engineering Majors at a Historically Black University. Egheosa P. Igbinoba, 2015: Applied Dissertation, Nova Southeastern University, Abraham S. Fischler School of Education. ERIC Descriptors: STEM Education, African American Achievement, Higher Education, Black Colleges, Engineering Education

Blacks are underrepresented amongst persons who earn college degrees in the United States and Black males attend and complete college at a lower rate than Black females (Toldson, Fry Brown, & Sutton, 2009). According to Toldson et al. (2009), this quandary may be attributed to Black males' apathy toward education in general, waning support and ideological challenges toward Pell Grants and affirmative action, cultural incompetency on the part of the 90% White, ethnic makeup of the U.S. teaching force, and the relatively high numbers of Black males who are held back in school.

In spite of the dismal statistics regarding Black male academic achievement and matriculation, there are those Black males who do participate in postsecondary education. While many studies have highlighted reasons that Black males do not achieve success in attending and persisting through college, few have adopted the anti-deficit research framework suggested by Harper (2010), identifying reasons Black males do persist in higher education. Although science, technology, engineering, and mathematics careers are identified as those most imperative to the economic competitiveness of the United States, few studies have concentrated solely on engineering majors and fewer, if any, solely on Black male engineering majors at an historically Black college and university.

The aim of this study was to address an apparent gap in the literature and invoke theories for recruitment, retention, and success of Black males in engineering degree programs by employing an anti-deficit achievement framework for research of students of color in science, technology, engineering, and mathematics. Data garnered from the study included insight into participants' definitions of success, precollege experiences, factors contributing to the persistence during undergraduate study, and perceptions of attending a historically Black college and university versus a primarily White institution.

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Chapter 1: Introduction

Statement of the Problem

Blacks are underrepresented amongst persons who earn college degrees in the United States and this problem is compounded by the fact that Black males attend and complete college at a lower rate than Black females (Toldson, Fry Brown, & Sutton, 2009). According to Toldson et al. (2009), this quandary may be attributed to Black male apathy toward education, in general; waning support and ideological challenges toward Pell Grants and affirmative action, cultural incompetency on the part of the 90% White ethnic makeup of the U.S. teaching force, and the relatively high numbers of Black males who are held back in school. By the time they reach the last 2 years of high school, Black males are nearly four times as likely to be held back in a grade level as White males, and are significantly more likely to be held back as Asians, Latinos, and students classified as other (Toldson et al., 2009). The achievement gap between Black males and their counterparts from other ethnic groups persists even for those who do manage to enter college (Palmer, Davis, & Maramba, 2010).

National data sets have been utilized to generate research, which has shown that demographic factors, including ethnicity, gender, parent education, family income, parental involvement, and family size are related to disparities in student achievement (Thompson, Gorin, Obeidat, & Chen, 2006). Additionally, achievement in high school is related to continuing education (Jacobson, Olsen, King Rice, Sweetland, & Ralph, 2001). Causes for the disparity in numbers of Black men in higher education include academic, career counseling in high school; expectations of high school teachers; counselors, parents, and other adults; teacher preparation; self-identity; and overall negative attitude toward education and scholarship (Hefner, 2004). Assessment of jobs and pay offered

with a high school diploma or less in comparison to a college degree contributes to the formation of negative attitudes toward education and scholarship (Hefner, 2004). While the causes for lagging Black male achievement in higher education has been addressed in research, in general, more studies are needed to find effective strategies for increasing college success levels for Black male undergraduates in specific majors.

Phenomenon of interest. According to the U.S. Department of Education and the National Center for Education Statistics (NCES), the numbers of students who have completed high school and continued their education in college has increased since 1980 (Aud, Fox, & KewalRemani, 2010). Despite these gains, variances persist among Whites, Blacks, Hispanics, Asians, Native Hawaiians or Other Pacific Islanders, American Indians or Alaska Natives, and students designated as multiracial in their rate of educational performance (Aud et al., 2010). Black students lag behind other ethnic groups with regard to educational achievement, persistence in high school and college, and outcomes of education, such as holding a bachelor's degree; lower unemployment rates; and median income (Aud et al., 2010). In addition to lagging behind other ethnic groups in terms of general educational achievement, racial achievement gaps in science, technology, engineering, and mathematics (STEM) fields persist, with Blacks lagging behind their White and Asian counterparts and Black males lagging behind Black females (Harper, 2010; Moore, 2006).

Achievement in the STEM fields of study is a national imperative. A STEM education is essential to economic development and competition in the global marketplace. The United States has a vested interest and mounting need to attract and retain underrepresented populations, such as Black males, in engineering fields; yet there is a dearth of literature that addresses this need (Moore, 2006). Furthermore, most

researchers who seek to answer questions vital to closing achievement gaps and narrowing attainment disparities in STEM focus on student deficits and failure rather than achievement (Harper, 2010).

The aim of this study is to address this gap in the literature and invoke theories for recruitment, retention, and success of Black males in engineering degree programs by employing an anti-deficit achievement framework for the research of students of color in STEM. The researcher anticipated that this study would be a viable resource for educational leaders and policymakers in their efforts to curb the trend of a lagging, Black, male presence in engineering scholarship and STEM achievement throughout the educational pipeline leading to higher education.

National data sets have been utilized to generate research, which has shown that demographic factors, including ethnicity, gender, parent education, family income, parental involvement, and family size, are related to disparities in student achievement (Thompson et al., 2006). According to the *2009 NAEP High School Transcript Study*, a periodic report that collects and analyzes transcript data from a representative sample of America's public and private high school graduates, in 2009, 21% of Black graduates completed a below standard curriculum (Nord et al., 2011). Additionally, achievement in high school is related to continuing education (Jacobson et al., 2001).

Background and justification. Blacks are proportionally underrepresented in higher education institutions and that Black males achieve at a lower level academically than their White and female counterparts (Bush & Bush, 2005; Esters & Mosby, 2007; Holsendolph, 2005; Thompson et al., 2006; Toldson et al., 2009). This is a trend that begins at the elementary and secondary levels of education in this nation and is evidenced in statistics gathered by the U.S. Census Bureau (Toldson et al., 2009). About 1.86% of

White male elementary school students are held back between Grades 1 and 4 compared to 3.23% of Black male students (Toldson et al., 2009). Decennial Census confirmed that since 1990, Black males have completed high school at a rate about 10.00% lower than that of White males (Toldson et al., 2009). In 2007, 31.00% of White males in the U.S. population had college degrees, compared with 15.00% of Black males (Toldson et al., 2009). The gap between Black and White male college attainments has continued to widen over time (Toldson et al., 2009). Toldson et al. (2009) pointed to defects in the pipeline from high school to college for Black males, which leads to apathy toward education, in general.

America's schooling system has historically been afflicted with disparity between the achievement levels of, resources supplied for, and opportunities afforded to minority and majority racial groups (Green, 1999; Marable, 2003). These inequalities were first confronted in a major way in the landmark case of *Brown v. Board of Education of Topeka Kansas* (1954). This case spawned the massive movement in the United States toward the abolishment of de jure segregation of public schools. Proponents of integration believed that desegregation would close achievement gaps and provide equal opportunity for Black students and their White counterparts. In 1954, the U.S. Supreme Court ruled that state-sanctioned public school segregation was a violation of the Equal Protection Clause of the Fourteenth Amendment to the U.S. Constitution (Green, 1999). A little over 50 years later, de facto segregation has taken the place of de jure segregation, and the problem of achievement gaps between minority and nonminority students persists. Hoffman and Llagas (2003) found that this trend may also be observed at the postsecondary level due to statistical trends, which demonstrates that Blacks are less likely than Whites to earn degrees. In addition to lagging behind other ethnic groups

in terms of general educational achievement, racial achievement gaps in science, technology, engineering and mathematics (STEM) fields persist with Blacks lagging behind their White and Asian counterparts and Black males lagging behind Black females (Harper, 2010; Moore, 2006; Smyth & McArdle, 2004).

Achievement in the STEM fields of study is a national imperative. There is a significant demand for citizens with postsecondary training in scientific, engineering, and mathematical fields of study (Smyth & McArdle, 2004). A STEM education is essential to economic development and competition in the global marketplace. The United States has a vested interest and mounting need to attract and retain underrepresented populations, such as African Americans males, in engineering fields; yet there is a dearth of literature that addresses this need (Moore, 2006). Furthermore, most studies, which do seek to answer questions vital to closing achievement gaps and narrowing attainment disparities in STEM, focus on student deficits and failure, rather than achievement (Harper, 2010).

According to the U.S. Department of Education, overall Black college enrollment rates have increased over the past several decades; however, Black female attendees outnumber males and Blacks remain less likely than Whites to earn a degree (Hoffman & Llagas, 2003). Black enrollment rates in colleges and universities rose from 9% to 11% between 1980 and 2000 and the college completion rate for Blacks increased since 1993, yet Whites were almost twice as likely as Black students to actually complete a bachelor's degree or higher in Year 2000 (Hoffman & Llagas, 2003). This was a grim statistic for Black men, as females made up 63% of the Black enrollment in higher education institutions in 2000 (Hoffman & Llagas, 2003).

So it is that Black males face jeopardy in the realm of higher education. Blacks

are underrepresented in the total number of students attending colleges and universities, larger numbers are dropping out of high school, and fewer are enrolling in college (Hefner, 2004). Factors identified as academic career counseling in high school, low rigor in high school classes, and the adults that students interact within the education pipeline as the causes for the relatively low numbers of Black men in higher education (Hefner, 2004; Thompson et al., 2006). Deficiency in teacher training, apathy toward education, and scholarships have been reported as causes for low Black male enrollment in colleges and universities (Hefner, 2004; Thompson et al., 2006). It is imperative that the causes for low college attrition amongst Black males be addressed and eliminated.

The future of America's postsecondary education systems rests on the elimination of disparities at every level. There are indisputably significant societal benefits to racial diversity in higher education, just as there are unquestionably significant societal benefits to integrated work forces, integrated residential areas, and integrated private and public schools at the elementary and secondary levels (Wood & Sherman, 2001). However, Logan, Minca, and Adar (2012) observed that members of many minority groups, especially Blacks, are underrepresented amongst student and faculty ranks throughout higher education. Additionally, significant barriers to equal access in higher education, such as disparities in elementary and secondary education opportunities based on the segregation of local school districts, have persisted in the 21st century (Logan et al., 2012). The lack of education contributes to increases in poverty levels and diminishes the aptitude of the American workforce (George, Neale, Van Horne, & Malcolm, 2001; Marable, 2003).

Fifty years ago, Blacks were extremely underrepresented in the academic and professional communities of science and engineering (Babco, 2001b). Those who did

find success in these fields primarily attended historically Black colleges and universities (HBCUs), which subsequently served as the primary employers of Black scientists and engineers (Babco, 2001b; Hines, 1997).

According to the data gathered through research sponsored by the National Science Foundation and the American Association for the Advancement of Science, Blacks have made significant advancements in the academic and professional communities of science and engineering, but there still exists a gap in terms of achievement, employment, and advancement in those fields when compared with Whites (George et al., 2001). Minority students lag behind their majority counterparts in obtaining degrees in the STEM areas (Babco, 2001a, 2001b; Nicholls, Wolfe, Besterfield-Sacre, Shuman, & Larpkiattaworn, 2007). Educational leaders and policymakers must work to ensure that students at every level of schooling and of every ethnic background are afforded equal opportunity for educational advancement. This is imperative to the social and economic health of the United States as a nation.

Engineers contribute to national interests in industry and business through the systems, products, and services they produce, allowing the United States to sustain economic competitiveness (Amelink & Creamer, 2010). Black males are disproportionately underrepresented amongst degree earners in the field of engineering (National Science Foundation, Division of Science Resources Statistics, 2006). Due to the contributions made by the engineering workforce to the national economy, the numbers of students who become engineering majors, their experiences while enrolled in those programs, and the demographic profile of students attaining a degree are imperative to the nation (Amelink & Creamer, 2010).

According to the National Science Foundation, Division of Science Resources

Statistics (2006), Black males earned 6.1% of all undergraduate degrees awarded to males in science and engineering majors in 2004. In comparison, White males earned 66.9% of science and engineering degrees awarded to males in 2004. Statistical data were pointed out in the literature, which showed that Black males consistently lag in higher educational attainment in STEM majors when compared with their White counterparts. In an effort to narrow or close this gap of disparity, Black males need to be encouraged to major in the STEM curricula. STEM weighs too heavily on the U.S. national interest and global competitiveness for Black males not to stake their claim to this initiative.

As a high school educator in a large, mid-Atlantic urban school district and doctoral candidate in education leadership, the researcher was interested in generating research to inform policy and practice in solidifying and streamlining the educational pipeline between high school and college for Black males. This is in an effort to aid in the cause to ensure that Black men are not left out of the sphere of influence as the United States seeks to maintain competitive footing in the global marketplace.

The researcher conducted this case study by recruiting recent graduates from the university that historically hosted the largest congregation of Black academics in the world, a medium-large, private, nonprofit, HBCU research institution in an urban metropolitan mid-Atlantic city of the United States. Current enrollment at the university approximates 11,000 students who come from virtually every state in the United States, the District of Columbia, and 108 countries around the world. According to the Office of the President at the university in this study, the university “traditionally has had the largest gathering of Black scholars in the world.”

The researcher conducted interviews with graduates just prior to this study from the university’s college of engineering. The college of engineering is one of 12 of the

university's schools and colleges, and houses six academic departments, including architecture, chemical engineering, civil and environmental engineering, electrical and computer engineering, mechanical engineering, and systems and computer science; offering accredited undergraduate, graduate, and professional programs, according to the records of the college of engineering study site. In 2011, there were 587 full-time students enrolled in the college of engineering. Of those students, 378 were males, according to the records of this university located in the northeastern United States.

Qualitative Research Approach

Gall, Gall, and Borg (2007) contended that qualitative research can help researchers to grasp the meaning that events, situations, experiences, and actions have for participants in the study. According to Gall et al., case study is the most widely used approach to qualitative inquiry in education. Researchers generally conduct case studies to produce a detailed description of a phenomenon, to develop possible explanations of a phenomenon, or to evaluate a phenomenon (Gall et al., 2007). Given the reasons for case studies and the researcher's decision to examine the experiences of males who succeeded as undergraduate engineering majors, a qualitative, case study approach best fit the structure to address the research questions and, thus, was utilized for the research study.

The aim of this study was to provide practitioners with information that could be used to improve programs and practice in preparing Black males for STEM study in higher education and facilitating persistence in the field. Case study research brings a case to life in a way that is unattainable using the statistical devices of quantitative research (Gall et al., 2007). Therefore, the readers of case study reports may have a better foundation for designing educational interventions or taking some other action than they would have by gleaning from only quantitative research reports.

Relevance to the Discipline

Education is a key component in the attainment of social and economic status. Gaps in educational achievement exist between ethnic and gender groups in the United States. Black males lag behind their gender and ethnic counterparts in educational achievement, in general, with even larger disparities in achievement in the STEM fields. It is incumbent upon educators at every level of the educational pipeline to seek and employ strategies to narrow achievement gaps among students.

Deficiencies in the evidence. While there was literature addressing the problem of lagging Black male achievement in the undergraduate STEM majors, many of the studies were more than 5 to 10 years old. In addition, most studies published on the subject also concentrated on Black males enrolled in primarily White institutions (PWIs), although enrollment in HBCUs included 10.6% of total Black enrollment in American universities as late as 2007 (Aud et al., 2010). A need existed for investigation into fresh perspectives from Black males regarding their achievement in respective STEM areas and a concentration on those attending HBCUs.

Audience. This case study contributed to the body of research that guides practice and identify areas for further theorizing, research, development, and implications for school counselors, teachers, professors, education administrators and policymakers. Parents could also benefit from the study as they provided support and encouragement for Black males in the educational pipeline leading to higher education and successful completion of degrees in STEM areas, especially engineering majors.

Definition of Terms

The definitions of the following terms are intended to ensure uniformity and an understanding of the terms throughout this study. The researcher provided all definitions

not accompanied by a citation.

Black is a term that will be used interchangeably with African American and Black in this study and refers to students who identify themselves with the ethnic group of people born in the United States and are descendants of African ancestors.

Historically Black colleges and universities (HBCUs), according to Aud et al. (2010), "are those that were established prior to 1964 and have the principal mission of educating Black Americans" (p. 130).

Primarily White institutions (PWIs) include those higher education institutions that have historically and currently enrol a majority White (of Caucasian or European descent) student body.

Science, technology, engineering, and mathematics (STEM) is a term used to describe the academic areas. According to the *STEM Education in Southwestern Pennsylvania* (2008), "STEM . . . originally used by the education-related programs of the National Science Foundation (NSF), but not explicitly defined by NSF" (p. 3).

Purpose of the Study

This purpose of this case study was to explore critical factors associated with the success of Black males in engineering majors. It was important to understand the perceptions of Black males as they related to their personal and academic experiences. The aim of this study was to highlight the experiences before and during college that compelled the subjects to excel as engineering students. The themes and factors related to policies, programs, resources, and people that contributed to these men persisting and earning degrees in engineering majors discovered in the study could be utilized in the formulation of interventions to address the problem of relatively low numbers of these students earning such degrees.

Chapter 2: Literature Review

Rationale

Gleaning from the literature, there was evidence showing disparity exists in higher education between Black males and Black females. Black males consistently lag behind their female counterparts with regard to higher education attainment (Bush & Bush, 2005; Holsendolph, 2005). In fact, according to Roach (2007), "Black males have the worst college attrition rate among both sexes and all racial/ethnic groups in higher education" (p. 15). This crisis in the realm of higher learning has socioeconomic consequences for Black men, such as a decline in median household income and health status, and must be addressed with urgency by educational leaders (Hefner, 2004; Jackson & Moore, 2006; Thompson et al., 2006).

Conceptual Framework

In this research, the crisis and the nature of the study called for a qualitative, case study, research design consisting of individual interviews. The form of research design was used in Moore, Madison-Colmore, and Smith (2003), which investigated the persistence of Black males in engineering programs at primarily White higher education institutions. Moore et al. asserted that this method allowed for the collection of in-depth data reflective of the participants' experiences.

This study was modeled, according to Harper's (2010) anti-deficit achievement framework, which provided a method for exploring "why Black men excel instead of adding to the already well-understood reasons why they fail" (p. 66). The framework consisted of a series of possible research questions that researchers could investigate to better understand how students of color effectively traverse the various junctures of the STEM pipeline in education (Harper, 2010). According to Harper, the framework

provided a sample of

> anti-deficit questions that would shed light on three pipeline points (precollege socialization and readiness, college achievement, and postcollege achievement in STEM) . . . [along with] nine researchable dimensions of achievement (familial factors), K-12 [kindergarten to Grade 12] school forces, out-of-school college preparatory experiences, classroom interactions, out-of-class engagement, experiential and external opportunities, industry careers, graduate school enrollment, and research careers. (p. 68)

Historical context. In 2012, the 29th anniversary of the release of the pivotal *A Nation at Risk: The Imperative for Educational Reform* (NAR) report, which was presented by the National Commission on Excellence in Education, was marked (Caboni & Adisu, 2004). On August 26, 1981, Secretary of Education Bell formed the National Commission on Excellence in Education and charged that body with presenting a report of the quality of American education by April 1983 (Caboni & Adisu, 2004). In that document, the National Commission on Excellence in Education itemized issues facing American education and offered solutions to the problems that were identified (Caboni & Adisu, 2004). Pertaining directly to higher education, the NAR found that students were leaving high school without having been exposed to basic coursework necessary to successfully pursue a college degree. The NAR included recommendations that intermittent testing should be conducted at the high school level to determine the need for remediation or accelerated learning (Caboni & Adisu, 2004). In the report, there were several recommendations for the reform of U.S. postsecondary education, which included directives for improvements in curriculum, remediation, and teaching (Caboni & Adisu, 2004). Though the NAR prompted many changes in the American education system, the outlook for Black males regarding the pursuit of higher learning remained grim.

Experiential context. As a Black educator and mother of two Black males, the researcher invested in contributing to the body of knowledge, which informs the policy

and practice with regard to improving the rates of persistence and success for Black males in STEM fields. The researcher recognized the urgency of this issue as it related to the academic, economic and social implications for Black males. The researcher was the daughter of a Black man who earned a doctor of philosophy degree in an engineering field, and had three brothers who were unsuccessful in the STEM subjects in the kindergarten to Grade 12 education and chose social science majors as undergraduate students. The researcher was committed to identifying factors that could aid in preparing and encouraging Black males in engineering studies; this commitment was dedicated to both the students and sons of the researcher. It was the researcher's belief that increasing the numbers of Black male scholars in engineering and other STEM fields would increase their sphere of influence in the contemporary knowledge-, information-, and technology-based global society.

Context of the Study

Further research conducted in the fashion of the National Black Male Achievement Study (focus on success versus failure) could provide insight regarding improving Black male success at a particular institution, in a particular state, or in certain areas of study. Hoffman and Llagas (2003) showed that compared to the national distribution of degrees earned, Blacks earned lower percentages of bachelor's, master's, and doctoral degrees in engineering and science-related fields. Studies, which expose central themes that are imperative for improving the presence of Black males in fields related to STEM, were limited (Jackson & Moore, 2006). Even fewer studies included an examination of these factors as they relate specifically to engineering majors at HBCUs. The researcher aimed to address this gap in the literature:

1. How did precollege personal, academic, and social experiences of participants

"influence their pursuit of engineering majors?

2. How do participants perceive their academic experiences at a HBCU compared with Black males in a predominantly White college of engineering?

3. How did established relationships with faculty and peers, and support and encouragement from these sources contribute to the persistence of participants?

Available literature may be classified by three areas of emphasis. There were researchers that focus on exposing the issue of lagging Black male achievement in higher education (Bush & Bush, 2005; Esters & Mosby, 2007; Hefner, 2004; Herndon & Hirt, 2004; Hoffman & Llagas, 2003; Jackson & Moore, 2006; Thompson et al., 2006). There were also researchers who presented and discussed causes of the problem (Hefner, 2004; Holsendolph, 2005; Marable, 2003). Another set of researchers prescribed ways that educational leaders could and were working to curb the crisis (Hefner, 2004; Herndon & Hirt, 2004; Holsendolph, 2005; Jackson & Moore, 2006; Roach, 2007).

Low Black Male College Attrition

A corpus of literature existed, which included discussions of the failure of Black males to achieve at the level of their female counterparts in the pursuit of higher education. Hoffman and Llagas (2003) noted statistics gathered by the NCES, which showed that Black females enrolled and completed college at a much higher proportion than Black males between 1980 and 2000. This trend persisted in the first decade of the 21st century as evidenced by Aud et al. (2010). According the Aud et al. study, the gender gap for enrollment was the highest amongst Black undergraduates with females accounting for 64% of Black undergraduate attendees in 2008.

Malone and Barabino (2009) found that minority students' participation on STEM classroom activities may be adversely affected by circumstances at PWIs. According to

the Malone and Barabino research, adverse effects may partly be attributed to feelings of isolation and the burden of representing their race. According to Malone and Barabino, one participant in their study, a postdoctoral engineering student, described a personal experience as feeling like

> a speck of pepper in a sea of salt. . . . [Black students in STEM graduate settings were found to face the challenges of] invisibility, marginalization, undervaluation/recognition, representing the race, added taxes of being a person of color, exclusion (out of the loop), and racialization (related to stereotypes and never being able to escape being seen as a Black person). (pp. 486-495)

This conclusion echoed that of Moore et al. (2003) in their findings that Black males in engineering disciplines at PWIs felt burdened to represent their race and prove negative stereotypes wrong. These factors contribute to the stagnant percentages of minorities within the ranks of engineering faculty and at all levels of engineering education (Malone & Barabino, 2009).

Various studies contributed to the knowledge base regarding the social and academic causes attributed to Black males lagging behind their gender and ethnic counterparts in STEM achievement. The disparities in achievement appear as early as the elementary level in the educational pipeline leading through higher education, indicating a serious need to redress the issue. Some of the data conflict as in the cases of evidence presented (Bhattacharyya, Mead, & Nathaniel, 2011; Riegle-Crumb, Moore, & Ramos-Wada, 2010). While some researchers investigated pitfalls affecting STEM achievement for minority students at PWIs, there existed a gap in the literature as it related to the experiences of STEM students at HBCUs. More investigation into this matter was warranted.

According to Hefner (2004), this was not to suggest that the concrete number of Black men enrolling and graduating from college has diminished over the last 20 years,

but it does mean that the rate of growth over that time period is slower and that other groups are becoming far more educated in relation to their numbers amongst the total population of the United States. Jackson and Moore (2006) found that Black males lag behind Black females and White males throughout the educational pipeline in the United States. Jackson and Moore suggested that negative characterizations and the perpetuation of negative stereotypes regarding Black males contribute to the challenges that Black men face in American society and bleak national statistics related to mental and physical health, unemployment, incarceration, and education.

Although the numbers of Black male college attendees increased overall, their graduation rates continued to lag behind those of their gender and ethnic counterparts. Esters and Mosby (2007) found that, according to the Spring 2006 Integrated Postsecondary Education Data System Survey, Black non-Hispanic male students had the lowest 3-year graduation rate among all minority, male, community college students at 16% as compared with Asian and Hispanic males. Bush and Bush (2005) addressed the problem of Black male attrition at community colleges in the state of California with similar findings. There was significant evidence that this trend in higher education existed and other researchers sought to identify possible causes of the problem.

Factors Associated With Low Black Male College Attrition

The problem of lagging Black male achievement in colleges and universities has been attributed to multifaceted social, economic, and educational causes. The problem takes root in high schools (Caboni & Adisu, 2004; Hefner, 2004). Clayton (as cited in Caboni & Adisu, 2004) of Morehouse College identified the causes for the relative waning numbers of Black men in higher education to be the type of academic and career counseling Black males receive in high school; the lowered expectations high school

teachers, counselors, parents, and other adults have for them; the lack of exposure to a sufficient college preparatory curriculum; the quality of their teachers, and the financial status of their families. Other scholars pointed to rising tuition rates and declining federal aid, paired with the fact that Black boys in public schools are increasingly being instructed by White female teachers who are more likely to mark them as discipline problems (Hefner, 2004). In the mid-1980s and 1990s, legislation restricting those convicted of felony or drug-related offenses from eligibility for scholarship programs and tax credits for college tuition was enacted (Hefner, 2004; Marable, 2003). Citing these developments, Hefner (2004) and Marable (2003) theorized that Black men enrolling in college at lower rates than other groups was related to the increase in incarceration rates. Holsendolph (2005) found that Black men also have difficulty adjusting to several factors in college life; specifically, the admissions process, social issues with peers, interaction with professors and authority figures, and lack of organizational skills.

Precollege Social and Academic Experiences

Researchers attributed the difficulty that many Black males confront with regard to a persistence in college life with precollege social and academic experiences. Several studies were attempts to explore gaps in achievement in science and mathematics along gender and ethic lines. Kohlhaas, Lin, and Chu (2010) revealed that gaps in science achievement appeared as early as the third grade upon examination of the earliest national science assessment results. Kohlhaas et al. found that socioeconomic differences, ethnicity, and poverty levels had a direct relationship with science performance with Black males living below, at, or above the poverty in scoring below other ethnic groups. Another study, which explored the relationship of family support and ethnic minority students' achievement in science and mathematics, included findings that parental

expectations, parenting style, and parental involvement were essential to academic outcomes, such as standardized test scores when measured by the mother encouraging children to undertake advanced science and mathematics courses in eighth grade for at-risk, urban, minority students (Smith & Hausafus, 1998).

Maton, Hrabowski, and Schmitt (2000) concluded that there is a direct positive relationship between performance in postsecondary college science classes and participation in advanced science classes at the secondary level. This concept was explored by Rascoe and Atwater (2005) who concluded that the science classroom teacher could exert considerable influence on the science achievement of Black male students in high school. Rascoe and Atwater found that academic self-perception had a major influence on academic achievement. Rascoe and Atwater recommended that teachers actively seek to validate students and to teach them to "understand the psychology of the game of achievement" (p. 909). Denson and Hill (2010) examined the impact of an engineering mentorship program on the perceptions and self-efficacy of Black, male, high school students in the area of mathematics, raising questions about activities designed to diversify the field of engineering. Their study provided a model for the evaluation of engineering mentorship programs.

Riegle-Crumb and King (2010) found that Black male students report that they enjoy science and many have future aspirations for careers in science; however, they lag behind their White counterparts in persistence in the STEM majors. Riegle-Crumb and King posited that low persistence may be a result of struggles to meet academic prerequisites, less access to social and economic resources, and, perhaps, discriminatory environments. In contrast, Bhattacharyya et al. (2011) found low aspirations for science careers amongst Black students in their study of the influence of science summer camp

on Black students' career choices. The Bhattacharyya et al. study reported that students were intimidated by the idea of pursuing science careers perhaps due to low grades and achievement in science classes.

Various studies contributed to the knowledge base regarding the precollege social and academic causes attributed to Black males lagging behind their gender and ethnic counterparts in STEM achievement. The disparities in achievement appear as early as the elementary level in the educational pipeline leading to higher education; indicating a serious need to redress the issue. Because some of the data conflicts, as in the cases of evidence presented Bhattacharyya et al. (2011) and Riegle-Crumb, Moore, and Ramos-Wada (2010), more investigation into the matter is warranted.

Existing and Past Programs and Studies

Because the problem of lagging Black male achievement has gained attention, some educational leaders and researchers are trying to redress it through programming and studies aimed at informing stakeholders of what they can do to close the achievement gap. Corporations, government agencies, researchers, and teachers are collecting ideas to tackle the problem through funding and implementing academic assistance programs, even as it seems the genesis of much of the problem is in society, not campus outreach (Holsendolph, 2005; Roach, 2006). The state of Georgia funds a program titled the African American Male Initiative to address lagging achievement in its 34-college system through research leading to programs on college campuses (Holsendolph, 2005). The Call Me Mister program at Clemson University is a program to train Black male teachers. The Pacesetters Scholars Program at Okaloosa-Walton Community College in north Florida, and the Melvin W. Jones Scholars Community at University of Nebraska are programs, in which educators seek to address the specific needs of Black males on their campuses

by helping the students to adjust to college life, including the admissions process, interacting with peers, teachers and authority figures; and developing organizational skills (Holsendolph, 2005).

Researchers pointed to strategies that may be utilized by Black families to support their aspiring students. Herndon and Hirt (2004) assessed the role of the Black family support in retaining Black students in colleges and universities. The findings of their study provided a model of the connections between family and success in college among Black students. The Herndon and Hirt model includes a suggestion that the foundation for college success is laid in childhood, and is cultivated throughout the different stages of the college career. Herndon and Hirt suggested that a family that wishes to send their children to college needs to establish expectations with respect to education early in the lives of those children, and instill values and beliefs that would cause the children to persevere through difficulty in achieving their goals. For families in which no one has previously attended college, extended family and friends plus church members and neighbors who have attended college can help by talking with school counselors, encouraging children to participate in federal or state college preparation programs, and taking whatever steps they can to help children understand how to succeed as a minority in a majority culture.

Academic publications documented recognition of the need to disseminate information for the use of educators in addressing problems related to the education of Black males. In 2006, *Teachers College Record* devoted an entire special issue to literature on the education of Black males in an effort to strengthen the ability of educational policymakers, researchers, and practitioners to address related concerns (Jackson & Moore, 2006). There was also a national study aimed at addressing lagging

Black male achievement in higher education, which began in 2005 (Roach, 2007).

Studying High Achievement Versus Failure

According to Roach (2007), the National Black Male College Achievement Study (NBMCAS) was poised to provide a comprehensive resource regarding Black men in higher education. Harper of the University of Pennsylvania began surveying Black male students on 42 campuses in 20 states in early 2005 (Roach, 2007). Harper asserted that the answers to solving Black male college enrollment and retention rates lie in knowing what successful Black male students do, the kind of backgrounds they come from, and what their experiences were before they went to college (Roach, 2007). A majority of the research related to Black males in higher education focused on underachievement and scholars agreed that it is essential to unveil the academic, racial, and social experiences of high-achieving Black males (Bonner, 2001; Harper, 2005).

Most previous empirical studies examining Black male attainment in STEM amplified deficits and failure as opposed to achievement (Harper, 2010). Harper (2010) set forth an "anti-deficit achievement framework for research on students of color at various junctures in the STEM pipeline" (p. 64). This framework is an outgrowth of the NBMCAS. The NBMCAS surpassed the deficit perspective to highlight resources, policies, programs, and institutional agents that helped Black men achieve positive educational outcomes across various institutional contexts (Harper, 2010). Fifth-one (23.3%) respondents in the NBMCAS were STEM majors (Harper, 2010). The interviews placed significant emphasis on the young men's precollege experiences and the role of significant others, parents, and peers in the development of their college aspirations and understanding what compelled them to remain engaged inside and outside of classrooms was elected over exploring why Black men are disengaged on college campuses (Harper,

2010). The study adopted the approach of understanding how the students acquired the resources, and social and cultural capital that they lacked before entering their respective colleges and universities (Harper, 2010). Harper was praised by contemporaries for studying Black males in terms of high achievement, rather than in terms of failure, which is the more archetypal method (Roach, 2007).

Stinson (2006) highlighted the need for more inquiry regarding Black students who embrace education and achieve academically. Stinson asserted that research conducted with the discourse of achievement was limited, but imperative, to providing helpful indications for school administrators, teachers, and family and community members regarding the education of Black children. While Harper (2010) and Stinson aimed to promote the idea of more research focused on success stories amongst historically marginalized students (especially Black males), in contrast with the NBMCAS, Stinson's writing referred to Black male adolescents and mathematics.

This was also the case in the research of Matthews and Williams (2007). Their writing was focused on the education of young Black men in public schools. Matthews and Williams posited that more attention should be given to how young Black men achieve academically in spite of historical institutional and societal barriers, rather than continuing to catalogue deficits associated with those young men who do not. The thought of Matthews and Williams was that previous efforts to address the experiences of Black men in school had commonly been "driven by media-led conversation featuring such terms as plight, . . . endangered species, . . . at-risk, . . . lost generation, . . . [and] victims" (p. 188). They asserted that this sort of public diatribe worked to reinforce a victim status upon Black men. Matthews and Williams called for a rejection of deficit language popularly ascribed in research of Black men. Although the Matthews and

Williams research, like that of Stinson, was focused on public schooling, the ideas set forth in the study are relevant for research in higher education.

It was Harper's contention that higher education is a good for the public at large, but benefits too few Black men in America (Roach, 2007). This sentiment is echoed in the growing body of research regarding Black achievement in the United States. While the problem has gained the attention of scholars and educators, more research is being conducted and is needed to shed light on decision making in the policy and practices being implemented to improve the conditions of education for Black males (Jackson & Moore, 2006). Yet, respective works on Black males have primarily examined their challenges from a broad point of view (Jackson & Moore, 2006).

Previous Studies Focused on Black Male Achievement in Engineering Majors

For many years, researchers examined the shortage of Black males on college campuses and focused on how environmental and cultural factors affect educational experiences of such students (Cuyjet, 2006; Davis 1994; Moore, 2006). Other scholars sought factors that influence their decisions in choosing academic majors and careers, including precollege exposures, interests, skills, and academic experiences (Hines, 1997; Maton & Hrabowski, 2004; Moore, 2006). Many of the studies appeared in both popular and scientific publications (Hines, 1997; Hrabowski & Pearson, 1993; Moore et al., 2003; Powell, 1990).

While scholars agreed that the lack of minority presence in engineering studies is of profound importance, the body of knowledge, which specifically addresses the experiences of Black males in science and engineering majors is limited (Amelink & Creamer, 2010; Conrad, Conetto, MacPhee, & Farro, 2009; Moore et al., 2003; Roach, 2006). Previous studies in this realm focused on Black males attending primarily White

colleges and universities, and on attracting high achieving, but socially and economically disadvantaged students (male and female) to the fields of physical science and engineering, and predicting STEM enrollment for Black males along with other minority group students (Conrad et al., 2009; Moore et al., 2003; Nicholls et al., 2007; Sanders, 2010). The studies contained reports of socioeconomic and experiential variables that can influence minority students' achievement in science and engineering studies at the college level. According to *The Educational Effectiveness of Historically Black Colleges and Universities* (2010), the previously unobserved area of Black engineering students at a HBCU is also an interesting element to consider because HBCUs "produce 40% of Black engineers with only 20% of Black enrollment" in higher education (p. 2).

A wide range of factors have been identified in the examination of male and female minority student participation in STEM majors, including grade point average, mathematical ability, computer skills, passion for scientific research, potential social applications of scientific expertise, employment and financial prospects, ability to have fun doing physical science or engineering, meaningful relationships with peers and faculty in the sciences, and determination (Conrad et al., 2009; Moore et al., 2003; Nicholls et al., 2007). Still, there existed a gap in the literature as it pertains specifically to the experiences of Black males who attended a HBCU and completed an engineering degree. There was a need to address this gap.

The science and engineering workforce in the United States is understaffed and in need of a diversity of talents (Conrad et al., 2009). According to the National Science Foundation, growth in the engineering labor force is a critical factor in the maintenance of scientific and economic competitiveness for this nation (Amelink & Creamer, 2010; Conrad et al., 2009; Riegle-Crumb & King, 2010). Due to the perpetual, growing

advancements in technology, adequate preparation in science and mathematics has become imperative for entry into and persistence in the information- and knowledge-based contemporary workforce (Hrabowski, 2002; Moore, 2006). Colleges and universities are not producing sufficient numbers of engineers to fill projected positions (Babco, 2001a, 2001b; Moore, 2006). Blacks, Latinos, and Native Americans are particularly underrepresented (Moore, 2006). Increasing the participation of talented individuals from underrepresented groups can aid in the efforts to ameliorate staffing shortages and boost innovation and creativity (Conrad et al., 2009; Sanders, 2010).

Although it is evident that STEM fields are inextricably linked to national innovation and prosperity, there was a lack of research that included examinations of trends regarding equity among cohorts of students entering higher education after the millennium (Riegle-Crumb & King, 2010). Riegle-Crumb and King (2010) sought to address the gap by examining physical science, and engineering and biological science majors. Their study focused on the persistence of male and female, Black, White, and Hispanic STEM majors at primarily White, 4-year institutions. Black and Hispanic male college matriculants were just as likely to enter STEM majors as White males, still they persist at lower rates than their counterparts (Riegle-Crumb & King, 2010).

More research is needed to address the reasons that minority students do persist in STEM majors. Most previous research addressed the quandary of Black male achievement in the STEM areas from a broad perspective. That is, Black males were studied along with other minorities and within the STEM fields outside engineering. Studies leading to an improvement in the numbers of Black males attaining degrees in engineering majors will contribute to efforts to improve Black male achievement in higher education overall, as well as aid in the country's efforts to maintain its stance as a

leader in the global economy.

Conclusions

According to the literature, it was known that Black male students lag in higher education enrollment and completion (Aud et al., 2010). Additionally and more specifically, there exists a race and gender gap in STEM fields for Black males throughout the education pipeline (Aud et al., 2010; Harper, 2010; Hrabowski, 2002; Hrabowski & Maton, 1995; Riegle-Crumb et al., 2010; Stinson, 2006). This achievement gap had been attributed to a lack of knowledge and skills, motivational support, self-perceptions of ability, low teacher expectations, and poverty, amongst other reasons (Denson & Hill, 2010; Hrabowski & Maton, 1995; Kohlhaas et al., 2010; Rascoe & Atwater, 2005; Stinson, 2006). There were many studies highlighting Black male underachievement; however, researchers began to call for more research exploring the cases of academically successful Black students in order to address the observed gap in the literature (Harper, 2010; Matthews & Williams, 2007; Stinson, 2006).

Several additional gaps exist in the corpus of literature regarding Black males in the STEM majors. Many studies focused on this topic were discovered through searching electronic databases, but were too outdated (more than 5 to 10 years old) to be utilized for this literature review. In addition, many studies focused on science and mathematics achievement in kindergarten to Grade 12 education, as opposed to postsecondary education. While the limited past literature regarding undergraduate STEM achievement revealed factors associated with persistence in such majors or lack thereof, there was limited research addressing engineering majors and Black males in isolation from Black females or other ethnic minority groups. Even further, no recently published studies addressed the topic with regard to undergraduate engineering students at a historically

Black institution. While the NBMCAS did include some participants from HBCUs, the study did not focus on STEM or engineering majors in isolation.

In the literature, it was maintained that the exploration of factors associated STEM achievement in education and the subsequent use of conclusions in the formation of programs and policies to raise achievement levels is a national imperative (Bhattacharyya et al., 2011; Denson & Hill, 2010; Hrabowski, 2002; Kohlhaas et al., 2010; Riegle-Crumb, Moore, & Ramos-Wada, 2010). Reports published by the National Academy of Science asserted that more trained STEM workers are needed to preserve the economic supremacy of the United States and that individuals from all backgrounds must participate to meet the increasing demand (Riegle-Crumb, Moore, & Ramos-Wada, 2010). Because Black males lag behind their gender and ethnic counterparts in STEM achievement, there is a clear need for more research in the realm of undergraduate achievement of Black males in engineering majors. The previously unobserved area of Black engineering students at a HBCU is also an interesting element to consider.

Research Questions

Three research questions guided this study:

1. How did the precollege personal, academic, and social experiences of participants influence their pursuit of engineering majors?

2. How do participants perceive their academic experiences at a HBCU compared with Black males in a predominantly White college of engineering?

3. How did established relationships with faculty and peers, and support and encouragement from these sources contribute to the persistence of participants?

Chapter 3: Methodology

Aim of the Study

The aim of this study was to derive tentative hypotheses to provide practitioners with information that may be used to drive the theory. This information was required in order to improve programs and practice in preparing Black males for STEM study and persistence in higher education, especially engineering majors.

Participants

The participants for this case study involved four individuals. Gall et al. (2007) asserted the sample size in case studies is typically small and that this strategy serves the purposes of documenting the range of variation of the subjects and determining common outcomes, patterns, and themes across the variation. The participants for this case study were recent graduates of the college of engineering at this historically Black institution. They were self-identified Black males who graduated from the college with a degree in engineering between 2012 and 2014 and were aged 21 to 25 years. These individuals were recruited by means of digital flyers.

The researcher utilized random purposeful and homogenous sampling in recruiting the participants. Gall et al. (2007) stated, “In purposeful sampling, the goal is to select cases that are likely to be ‘information-rich’ with respect to the purposes of the study” (p. 178). The purpose of homogenous sampling is to select comparable cases so that the specific group that the sample represents may be studied in depth (Gall et al., 2007).

Procedures

During Winter 2013, the researcher developed the proposal. After the proposal was approved by the dissertation committee, the researcher drafted an invitation flyer for

potential case study participants to be submitted in conjunction with the proposal for approval by the Institutional Review Board. During the early spring of 2014 and following permission by the Institutional Review Board, the researcher electronically dispensed the flyer to potential case study subjects. Four individuals were chosen from the invitation letter respondents. The candidates were qualified or eliminated based on their demographic characteristics with respect to the requirements set forth in the planned methodology of the study. One face-to-face interview and three telephone interviews were conducted with the subjects. All interviews were recorded by means of digital audio recording device. Subsequently, the audio recordings were transcribed and processed for coding and analysis using NVivo10 Qualitative Research Data Analysis software. In the spring of 2015, the results and conclusions garnered from the research were assembled in narrative form, resulting in the completion of the final dissertation report. The researcher submitted the final report for review and approval in late spring of 2015.

Strategies of inquiry. This study took the form of a multiple case study because this form of research is effective in helping researchers to comprehend the meaning that events, situations, experiences, and actions have for study participants; and to understand the context in which the participants in the study are operating and its influence on their actions (Gall et al., 2007). In addition, case study methods can help researchers to develop causal accounts and explanations based on process rather than by showing a relationship between two variables as is the case in quantitative research (Gall et al., 2007). Case studies are generally conducted for the purpose of developing possible explanations of phenomena (Gall et al., 2007). The research questions to be addressed in this study sought to explore the cases of Blacks who are successful in undergraduate engineering majors. According to Gall et al. (2007), this form of study also aids in

achieving the goal of generating results and theories that are "understandable and experientially credible, both to the participants in the study and to others" (p. 456). Qualitative researchers do not strive to provide certainty within their data sets, but rather that their assertions are plausible given the data (Bogdan & Biklen, 2007).

Data collection procedures. Data for this case study were collected by means of phone and face-to-face interviews. Participants were asked about academic and social factors contributing to their success as engineering majors. The researcher used an interview protocol containing 25 questions to be posed to each respondent. All interviews were recorded by means of an audio-recording device.

The researcher conducted interviews with the four solicited individuals from the targeted population in accordance with the preconstructed interview guide. Maxwell (2005) asserted that qualitative researchers customarily examine a relatively small number of individuals or situations, allowing the researcher to understand the particular context that the participants act within and the influence of this context on their experiences and actions.

The interviews were not be timed in order to allow respondents to share their opinions freely. The interviews lasted between 20 and about 85 minutes. Gall et al. (2007) suggested the researcher controlled the response situation by scheduling with the participant a mutually agreed upon time and location to conduct the interview, and then controlled the question pace and sequence to fit the circumstances of the situation. The researcher adhered to the Guidelines for Conducting a Research Interview set forth by Gall et al. in their *Educational Research* text and conformed to ethical standards of research.

In accordance with the assertion of Gall et al. (2007), the interview format was

that of a standardized open-ended interview, involving a "predetermined sequence and wording of the same set of questions to be asked of each respondent, in order to minimize possibility of bias" (p. 247). This format aided in ensuring that the data collected were systematic and thorough, and that questions were asked in the same way (Gall et al., 2007).

Instruments

The 25 questions to be asked of the participants were adapted from a study conducted by Palmer, Davis, and Maramba (2010; see Appendix A) and from the anti-deficit framework published by Harper (2010). Permission was requested and received to adapt and reprint the anti-deficit framework from Harper and the questions from Palmer, Davis, and Maramba.

Data Analysis

The data collected from the interviews were subsequently examined by means of interpretational analysis in order to generate categories and counts to be used in the formation of constructs, themes, and patterns using a case study approach (Gall et al., 2007). The constructivist approach involved the derivation of constructs and laws directly from the data collected by the researcher, rather than drawing on an existing research and theory (Gall et al., 2007). This method was appropriate for the intended qualitative study because it has been used successfully to conduct similar studies in academe (i.e., the NBMCAS) and served the researcher's aim of deriving tentative hypotheses to drive theory and practice in the near future (Gall et al., 2007; Palmer, Davis, & Maramba, 2010). The case study approach also allowed theory building to evolve from the data by way of contrast and comparison of concepts, subsequent integration of categories, and delimiting and writing up of emergent theories (Moore et al., 2003).

The researcher worked to ensure validity and quality through triangulation of data, collection of rich data, contextual completeness, intervention and pattern matching, comparison, peer examination, and researcher reflection (Gall et al., 2007). The researcher engaged in a constant comparison of the data. According to Jones et al. (as cited in Palmer, Davis, & Maramba, 2010), constant comparison of data engages the researcher in a process of simultaneous collection and analysis of data at all stages of the interpretation and data collection process, resulting in the identification of codes. Data were collected and transcribed verbatim from audio recordings. The researcher also utilized field note-taking to help form themes and describe visual observations. Member checking, having respondents review statements in the report for accuracy, was utilized to ensure a correct account of the emic perspective (Gall et al., 2007).

Subsequently, the researcher read all transcripts and developed a set of categories of themes garnered from the respondents with respect to each research question. NVivo was used to aid in this process. NVivo is a software program that supports qualitative research by aiding in the process of collecting, organizing, and analyzing the data from the interviews and audio (NVivo, 2012). The resulting categories were used to code the four transcripts to generate constricts, patterns, and themes from the categorical data (Gall et al., 2007).

Validity and Reliability

In order to ensure the quality and rigor of this qualitative study, the researcher employed several strategies prescribed by Gall et al. (2007) to meet the needs of the users, to ensure the use of sound research methods, and to ensure thoroughness of data collection. The study was useful to the participants in that it served to further the emancipation of Black males from the struggle for attainment in higher education and

particularly in STEM majors. The researcher constructed an audit trail documenting the research process and included samples of materials in the final report. The study materials will be kept for 5 years to permit others to inspect them. The final report also included direct quotes from research participants. The discussion of findings incorporated tacit knowledge in order to adequately convey the context of participants' perceptions and meanings. Rich data collection in the form of audio recordings, transcripts, and detailed notes of observations enabled a full and revealing picture of the interviews. The researcher engaged in coding checks and member checking by having the research participants review statements in the final report for accuracy and comprehensiveness.

Peer examination was employed in the requirement of the dissertation chair and committee member to review and approve the final report. Thick descriptions of contexts and participants aided readers in determining the applicability and generalizability of the research to the larger population of Black males.

Confidentiality

A signed consent form was obtained from each respondent at the start of the interview process (see Appendix B). The preinterview consent form was adapted from a sample consent form published on the University of College Cork, Ireland, web site (*Sample Informed Consent Form for Research Participants*, 2007).

Chapter 4: Findings

Four recently graduated undergraduate engineering majors from a mid-Atlantic historically Black college of engineering were interviewed to gain an understanding into their perceptions of factors contributing to the success of Black males in engineering majors. Several categories of major findings emerged from this study. Emergent themes included definitions of success, precollege experiences, factors contributing to the informants' persistence during undergraduate study, and perceptions of attending a HBCU versus a PWI.

Definitions of Success

Though the informants all defined success differently, each definition was reported to have changed over time. Additionally, the definition of success of three of the four respondents was altruistic in nature. As an example, Otis, a 23-year-old, chemical engineering graduate, expressed a definition of success that had transformed over time from being measured monetarily to having a basis in pursuing one's passions and happiness; both internally and in personal relationships. Craig, the only electrical engineering major, also defined success as related to pursuing one's passions, supporting Otis's assertion:

> To me, success is being able to live your passion, and I think that that's something that I've really been pushing towards discovering for myself since I've been, I guess . . . during my adult . . . adult years and since I came out here for school; just really seeing what is it that really fires me up and what am I really passionate about. And if I'm able to do that, then I would consider myself to be successful.

When asked how the definition of success had changed over time, 22-year-old, chemical engineering major, Dante, also reported that current definition of success as changing the status quo and conditions, such as those of childhood to a former basis on job and salary. For Michael, also a chemical engineering major, the definition was twofold and included

wealth as one aspect, but also included helping others. Michael explained that the other facet of success was measured in "How many people's lives you can touch; and, you know, how much, you know, jobs you can create for people; giving back to the community." Michael defined it as "helping people."

Precollege Experiences

Interviews with the respondents yielded several factors that stimulated their interest in pursuing engineering study or success in college. Major categories of factors consisted of family influences and academic experiences, in and out of school.

Family influences. All respondents conveyed that their family had impacted their academic pursuits. These influences came in various forms though high expectations were a recurrent theme. Every respondent conveyed that their families were supportive and encouraging with respect to their academic pursuits. Dante was the first in this family to attend college, though Dante's single parent mother was unable to lend much support with homework or advice pertaining to college admissions or areas of study, Dante's mother encouraged and supported his academic pursuits. Dante described this situation:

> I grew up in a single parent household. You know, so my father wasn't around for the majority of the time. Um, as a child, like, my mom worked two jobs or whatever, so you know, it's kind of like I was raised by my grandmother. Um, so you know I think there was always a sense of, like, you know, Do well in school. Do well in school. Do well in school, but it never seemed to, like, literally, you know . . . I'm thinking about, like, what I thought about as a kid, and really it was just, Do well in school. There wasn't this, like, attachment to college or anything until maybe, like, the ages of middle school and the beginning of high school. And then it was like, Oh, I've done well in school. Maybe I should think about going to college. So, you know, it shows . . . I think it's just one of those scenarios where it's like, you know, your parents or. . . . In my situation, my parents and my guardian tried to teach, you know, about academics. They did what they knew. They knew that you had to do well in school and they, you know. . . . My mom had started to realize that, you know, a high school diploma is not really worth that much anymore, so you kind of need to go to college. But no one had been to college, and so no one knew, like, you know, the SATs or how to take them, or what was gonna be on them. Or no one had known, you know, what, you know,

> professors . . . There's office hours for professors; or what dorm life is like or, you know, anything like that. So I would say up until high school . . . No, even when I got to high school, I'm taking, you know, classes that, um, my parents or whatever . . . They weren't able to really help me with homework or whatever; um, with what I was doing. So I think there is this sense of, like, just the emotion of the parents wanting you to do well; but not necessarily, like, a lot of, like, active things that they could do to help with academics besides like, you know, the sort of like staying on you; making sure that you're not making mistakes or making bad decisions or whatever.

For the other respondents, one or both parents had attended college and fostered academic experiences for them while growing. Otis' parents, father a scientist and mother a chemical engineer, worked for a multinational consumer goods company headquartered in the midwest. Craig's father was a veteran of the U.S. Marine Corps and a bus driver, while Craig's mother had recently earned a doctorate, but Craig credited an uncle as having the most significant impact on Craig's decision to pursue engineering study:

> As far as engineering, you know, I kind of credit that to my uncle who is an electrician, and I would. . . He would take me on jobs . . . different jobs throughout the city … just to see what he does, and I found it interesting – the little wires and how they were arranged behind the outlets; things like that. So it got me kind of curious when it came to picking a major. Like I said, I was looking at architecture, but electrical engineering kind of . . . I kind of remember my uncle working with electricity and things like that, so I got interested.

In-school academic experiences. Teachers played a significant role in fostering interest in science and math for two participants. Craig described personal experiences in a low-income area school and how teachers helped to encourage him:

> So this is actually, you know, a positive about, like, going to, like, high schools at a predominantly Black um . . . It's that . . . And the teaching complexions vary from high school to high school. Specifically, there are at least, you know, maybe I'd say a fourth of the teachers that are Black. And the teachers that are Black in those Black high schools, um, really care and they go above and beyond to sort of instill, you know, whatever subject it is that they are teaching. And so all of my math teachers from ninth to 10th . . . from ninth to 10th grade were exceptional, um, Black women that, you know, had been like the first, um, you know, to do a lot of stuff in their families; but, you know, also were amazing at math. And I think what that does is it sort of debunked the stereotype of . . . that . . . the cultural phenomenon of like, Oh, math and science is so apparently hard, like, no

> one can do it, you know, except for the great, and the strong and the brave. And you know, they definitely broke it down to a level where it was like, Oh, you know, this is not difficult; it's different, because you don't use complex math in your every day. But you know, if you're not an engineer or something, you don't see these types of things, and all it is an English, history, um, sort of like maybe basic math and natural science. You see these things every day, so it's easier to get the complex with things that you've seen outside of the classroom. And so I think teachers–specifically my teachers and other teachers–the thing that they do well is connecting these concepts with something you'll see every day. You hear almost all the time–or at least I did in high school–When am I ever gonna use this? When am I ever gonna use this? When am I ever gonna use this? And that sort of is the sentiment with learning. If you can connect, When am I ever gonna use this? to the students, it is much easier for them to grasp the information. I think my teachers were able to do that for me, and it was definitely, like, one of the reasons that I was able to go so far in the engineering field.

Teaching style was also a factor for Otis:

> maybe the reason that I got into actual chemical outside of my parents being involved in it at Proctor and Gamble was probably a teacher in one of my first AP classes I took which was AP Bio . . . provided me ways of looking at things which wasn't such a dry just regular class. It was interesting. A lot of experiments and just finding ways to pique interest in the subject . . . just a lot to do with teaching style. So I guess teachers who are passionate about it want to see you learning and excited about what they do.

Craig also viewed relationships with teachers as important:

> I remember one. Ms. Johnson was just very supportive inside and outside the classroom, so they took a personal interest in you and your success in whatever you did. You know, that's not just good either; you know, you mess up–or at least back then–they would kind of like, you know . . . They would discipline you and your parents would approve. So things like that made you feel like, Okay, these are like my extended family, so I need to do well. But they would . . . They would, uh, work with us on things that we didn't know; just was a mentor; played a mentorship-type role versus just a teacher

Otis and Dante reported taking Advanced Placement math or science classes in high school. They reported the Preliminary Scholastic Aptitude Test and National Merit Scholar Programs as helping them feel prepared for college. Dante felt that the level of rigor in some regular high school classes may not leave some students ill-prepared for the challenge of college level course work:

> A lot of times what you don't realize is that the high schools that you have gone through . . . gone to haven't had the resources necessary to equip you with the knowledge to do well in these fields. And it's not about, you know, your intelligence level. It's just that all these other people have had high schools or experiences where they've seen Calculus two semesters or sometimes 3 years over before they got to college and you haven't seen Calculus at all, you know? Or, you know, they've gone through AP Chemistry or taken dual enrollment classes at some college down the street and you haven't, you know . . . all you've done is high school Chemistry. And a lot of times in high school, Chemistry in a lot of American high schools isn't even up to standard to, you know . . . you know, what we call high school Chemistry. So I think you can't connect that oftentimes as a freshman or sophomore and you just think, Oh, well, I must be stupid because everyone else seems to be getting it and I'm not. So um, there is definitely that sense of, like, you know, America is not really equipping Black males to be good in that field; and then they have that sense of not being good, so you have to break through that.

When asked how they were able to negotiate math and science achievement alongside popularity in school, two respondents expressed that academic achievement was celebrated amongst their peers. The students who were popular were also achieving academically. Otis viewed this as a positive aspect of the precollege experience:

> it was a talented and academic high school so it wasn't like a lot of schools where it would be like uncool to be doing well in school. It was almost like everybody did pretty well. Just it wasn't a good thing if you did bad in school so that was a positive. Kids who were popular were also doing well and they actually cared about academics so that helped a lot.

Craig recounted a similar experience with the added notion of choosing comrades who saw academic achievement as something to be celebrated:

> It's like how do you play off the, uh, being a nerd and then trying to be cool at the same time. Uh, I think it's just who I chose to be around, you know? I chose to be around people who thought that was cool too, you know? They were also into math and science. One of my best friends is a chemical engineer, so we always were competing with each other, um, on everything; and uh, one of them just being engineering. But I think it's really just choosing who you . . . who you, uh . . . I chose who I wanted to hang around; and I went to a school I think that, uh, kind of celebrated that instead of treated it as a, uh . . . as something to be uh, you know, ashamed of or trying to hide from so . . .

Out-of-school activities. In addition to science fairs, along with math and science

clubs, three of the informants participated in precollege readiness programs. One of the programs was a general college achievement program and three were specifically geared toward STEM learning. One respondent participated in a program at the University of Cincinnati for minority students interested in math and science. Another recounted participating in a leadership academy for males at James Madison University during the sophomore year of high school. The third and fourth programs were implemented in the Detroit area:

> Well my mother put me in a program . . . several programs. One program I remember was called um GEMS, which was . . . I forget what the "G" stands for, but it's maybe Great Exploration in Math & Science. It was a program where we were making . . . working with different chemicals and things like that… DAPCEP is another program–Detroit Area Pre-College Engineering Program. My mother had me in that for about 2 to 3 years–me and my sister, and we learned a lot about different areas of engineering: drafting, computers, computer-aided drafting, things like that.

Factors contributed to the informants' persistence during undergraduate study. Respondents held the belief that they were successful as engineering majors due to family, faculty, peer, and personal factors.

Family factors. Their families influenced their success in various ways. For Michael, Michael's parents, and aunt and uncle lent spiritual, moral, and financial support. Michael felt able to concentrate on the rigors of being an engineering major due in part to not having to worry about how to pay for school fees or room and board during the 5 years as an undergraduate. Craig was able to call on Craig's mother for support when needed:

> Definitely having my mom there; you know, the person I'd call when I wasn't doing well; or when I might have not passed a class; or when I had to. . . . Or just dealing with everything, yeah, it would be my mother; having that parent there. Having that support was definitely, definitely helpful.

Both Craig and Dante reported family pressure to succeed as reasons for their persistence.

Craig mentioned "knowing that you can't go home without a degree" while Dante felt the pressure of being a role model for younger family members.

School faculty. All informants revealed that professors had a significant impact of their ability to persist to graduation. Michael appreciated helpful instructors:

> So the professors actually being able to, um, be flexible in their office hours; and being able to, like, transfer information, because a lot of professors know the stuff, but they don't know how to transfer the information. So having more of those kinds of professors who can actually transfer it, that's a big . . . That's a big deal.

Dante described being motivated by a particular professor who was personally affected when students failed to demonstrate understanding:

> The most significant people, I'm going to give to um . . . um, a couple classes of professor that I've had. So Dr. Patrick who, like, you know . . . who contacted me about, like, your dissertation study. Um, you know, he's a relatively young professor, and he came into the department at a time where, you know, a lot of the professors had left. And so we didn't get the benefit of speaking with them, and then the intermediate professors weren't good at all. And he could have come in and been like, oh, the new kid on the block teacher where it's like, oh, the students are, you know, taking advantage of him; this, that and the third; and it wasn't like that at all. You know, he grilled us. He stayed on top of us, and it was um . . . It was . . . It was crazy because you could tell, like, his emotions were, you know, not only just the material, but the well-being of the students. The first test we had in the class, the average was like, 70 or something. And you know you hear in engineering, Oh, well, you know, everyone does bad, so the average is 70. You know, That's fine. But I think most people made, like, *way under* the 70. But um, you know, he came in and he said, you know, it ruined his weekend to have to grade that and see people, like, get those low scores. And then he made us do a retake of the test that next week. And so I think from a student to professor standpoint, that was so rare at that time to see that–to see the professor go and say, Oh, you guys did bad. This hurt *me*. Because for the first two years in uh . . . in college, it felt like the professors were against you, you know? They wanted you to do bad. And maybe that's not the case, but you never felt any real sentiment to the opposite. And I think Dr. . . . was one of those professors where it was like . . . I mean he . . . He was being hard but, you know, he was really trying to get us to the level that we need to be to know about these things. So, I mean, I would say he's significant.

Craig appreciated professors who showed a vested interest in students. Craig fondly remembered working for a professor as an undergraduate assistant. Through this

relationship, Craig developed personal research, writing, and presenting skills; earning the opportunity to present a paper to industry professionals in San Francisco as an undergraduate.

Peer relationships. All four respondents viewed peer relationships as instrumental to their success in obtaining an engineering degree. Three respondents reported mentoring programs and relationships when asked who had played a significant role in their ability to become academically successful in engineering learning. Two programs pointed out were TRUST and the National Society of Black Engineers Mentoring Program. Trust was a program created by students and was less formal than the established program run through National Society of Black Engineers. Dante described how being a mentee, as well as a mentor helped to motivate Dante to do a personal best:

> So my junior year, um, we really got this mentoring program off the ground. And what we did that was a little different from past years was instead of trying to pair people one to one, which, you know, a lot of the time it didn't work out from the mentee perspective, and it was kind of like just a lottery type thing–what happened was they put us . . . they gave us groups of mentees. So there was about maybe seven to nine of us, um, which had a group of four to six mentees. And so what . . . You know, we had those mentees of our group, and they're kind of like families–like little small families; and then there would be a huge, big family. And you know, it was amazing. We had personal development, academic development, professional development. We had family dinners. We went and, you know, dropped off . . . took people from Baltimore. We'd talk about relationships with the mentees, you know? Just a range of topics, and I feel like it was nothing really off the table. Um, and we were really good at, um, you know, just helping each other. I think for me specifically, um, one, it made me be on top of everything that I was doing. Because if I'm gonna have to schedule in time to help out, you know, my mentees or anything, I have to make sure that my stuff is done completely because I don't know how long it might take to help them. So from a time management perspective, that was the best year probably that I enjoyed was when I became a mentor. I was able to schedule everything perfectly. I knew that not scheduling everything perfectly just, like, would lead to chaos. And then on the other hand as well, um, dealing . . . like . . . So I mean you think, like, mentoring is, like, all about teaching the mentee, and there is, like, basic things that I think that you can teach that maybe a freshman or a sophomore isn't

> really um, privy to; but I think, you know, it's always this conversation; and there's always things that you learn from your mentees that perhaps you didn't know yourself. So um, you know, that definitely, you know, spread our development as well because, you know, you had mentees who um, maybe, you know, were dealing with some pressures or whatever and they were persevering. And, you know, you look to them kind of like, Oh wow, that's amazing. I don't know if I could have made it through those types of obstacles to be here. Or you had mentees that, you know, were naturally just good at, like, connecting to people and stuff on their own. And if you weren't blessed with that talent, you might talk to them about that and, you know, they would share, you know, just their thoughts on how they would do that. So, at some point, it really becomes a dialogue. And, you know, some people look at mentor-mentee as this hierarchy thing where the mentor is inherently better than the mentee. But it's definitely a conversation in the likes of a parental . . . We likened it to siblings more than a parental type thing where, you know, I'm very much trying to be an older sibling to you, not your father. Um, that atmosphere just made everything more family like; less competitive. And when you have that atmosphere that was less competitive, I think students tend to do better because there's a lot more sharing of information; a lot more helping or understanding concepts, which just results in better grades.

Dante and Craig expressed that maintaining personal relationships outside the School of Engineering was important for them. They recalled that this aided them in being well-rounded and enabled needed breaks from the rigors of engineering study. Dante kept in touch with high school friends, remained active in religious and social life of campus, winning a pageant freshman year and being an active member of the university student association. Craig was a member of the school marching band and often interacted with friends in various other major areas of study.

Personal factors. Each participant identified engineering study as being difficult. When asked what personal factors contribute to the success of engineering majors, preparation, discipline, organization, focus, and perseverance emerged as main themes amongst the answers provided. Informants agreed that aspiring engineering majors should be aware that the work will be challenging and will require more time dedicated to studying than for some other majors outside the realm of STEM learning. They saw

acceptance of this fact as integral to success as an engineering major. Otis gave this advice for future engineering students:

> I guess part it's just accepting the fact that it wasn't going to be as normal of a college experience you know . . . cause I had a lot of friends who weren't engineering majors, probably a majority of my friends weren't. Just accepting the fact that the course load, the workload was going to be a lot more and that I'd have to put a lot more work towards it. That was probably I guess the biggest, I guess the biggest realization that I had to get to be successful. . . . Yeah, I guess that's the biggest one by far. You know that a lot of people just get overwhelmed at some point and . . . they just switch schools altogether and I guess the biggest advice I would give is just to go in fully expecting that it's going to be hard, it going to be difficult. Few people go into it because it's easy, you know, the reason why there's so many job offerings, why an engineering degree is looked at so highly is because of the hard work you're expected to know a lot, you're expected to understand really hard concepts so just go into it thinking that it's a lot of hard work, but not to expect that it will be easy just to work through cause it's definitely going to be challenging. . . so just to know what you're getting yourself into.

Dante recounted the story of a friend who attempted suicide in light of the rigors of college and offered that students adopt a mindset of feeling capable of doing anything, but being aware that one cannot achieve everything. According to Dante's philosophy, acceptance of and perseverance through failures is necessary for engineering majors:

> So I think on a personal level, um, during my sophomore year, um, one of my friends tried to commit suicide. And I think, like . . . And we were very close and went through high school together; um, everything like that; and um, I think, you know, I hadn't understood how much, like, this sort of thing weighs on people and . . . not just the . . . but like school and loans and the stress of like . . . He was also a first-generation college student; so, like, the stress of doing that. And then he had done very well up to college. In getting into college and then, you know, that being a whole different ball game and maybe struggling a little bit with it academically, there is this pressure to still do as well as you did in high school. Um, you know, I hadn't realized that and it was, you know, just crazy to me that, like, you know, this . . . you know, shifted my vision of, like, you know, these sorts of effects don't just stop at high school, or don't just stop at college. It's really important to try and ground yourself in something other than like, you know, I just need to make it to make it. I have to have something else backing it. And you have to be okay with not making it; and that sounds very, like, counterintuitive to a lot of people because it's like, Oh no. You just have to focus on making it. You have to focus on making it. But if you're not okay with feeling . . . sometimes the pressure is too much [inaudible] give up their lives and say . . .

> I mean I can't get 100% on everything. I can't be everything. You know, I can't do everything. I can do anything, but I can't do everything. And I think that that moment was when I started seeing that phrase. You know, I can do anything, but I can't do everything. It allowed me to realize that I can fail, and bad things can happen; but even inside of that, like, I still can accomplish, you know, whatever I set my mind to as far as, you know, a particular thing.

Dante also offered a personal philosophy and method for maintaining discipline and organization:

> What I would say is, you know, I know it's gonna be difficult . . . You know, I think . . . It's gonna be difficult trying to focus on doing, you know, well in academics versus, you know, being social; because social is very important, you know, as a Black cultural phenomenon in general; like, you know, there aren't many [inaudible at 49:14], I would say. Um, so I would say . . . You know, I would explain to them, like, there's a three-part triangle here. There's work, play, and sleep. You can pick any two parts of the triangle, but you cannot pick all three. So if you want to be successful . . . I mean, if you want to be good in academics and have a social life, be prepared to not get that much sleep. If you, um . . . You know, if you want sleep and good academics, be prepared to not be that social. And obviously the other part is, I mean, don't just be social and only get sleep because then clearly your academics are gonna suffer. And so I think that triangle, it has been used around the country in different . . . in a lot of different scenarios, and I use it even now to this day. And it was given to me in my freshman year, and I think that's also what I would give as well.

Additionally, respondents agreed that aspiring engineering majors should have reasons other than salary and prestige for choosing that field of study. Craig explained that sentiment:

> I would say uh, one, one key factor is to . . . [thinking aloud] Just look at your reasons . . . Look at your goals for going into this program, you know? Look long term, you know? Don't just go into it because you see that, you know, they have a high entry-level salary or it would be cool to tell the girls that you're an engineer and things like that. You know, you look at what your goals are. You know, if your goals . . . If your goal is to become a uh . . . a CEO, you know, look at, is engineering important to you as the CEO of an engineering company or something that like; and make sure that the major you pick aligns with your goals. And that's specific to engineers because of the reasons I mentioned before. You tend to go into it because of the things you hear and things you read. But once you actually get into the program, and then you graduate and get into the workforce, it can seem to be a lot different. But if you went into it for the right reasons, you know, you'll find . . . you'll find it enjoyable, you know, even when you find yourself just at a computer all day. You gotta . . . If you were into it for the right

> reasons, you'll find . . . you'll start, uh, asking for more work and you'll start going towards the things that you really wanna do in engineering.

Perceptions of Attending a HBCU Versus a PWI

All informants discussed the connection between attending a HBCU and their success in an engineering study. For them, the HBCU provided a safe and nurturing environment. They expressed appreciation for the peer relationships they formed in school and believed that this would not have been possible attending a PWI. Otis believed his experience may have been different had Otis attended a PWI:

> Also, if it was a Black male in a PWI, I'd say it would probably be a lot different just because if you look around just like nationally engineering schools aren't the most diverse places, especially for Black males so you would definitely . . . you . . . not being around peers that look like you . . . people to build friendships with, to have as much in common with . . . , which I think is one of the biggest pluses of going to a HBCU.

Michael felt,

> At home [at a HBCU], I actually felt at home. You know, I was never, you know what I mean . . . uh, racial biased, um, situation. I just felt like I was home, you know? Like everyone around me loved me. They didn't feel like they were better than me, so that kind of helped me, like, be at ease while I was doing what I was doing, you know? It, like, reduced the pressure on me.

Dante also elaborated on feelings of pressure relief in attending a HBCU:

> I feel like . . . that as a Black male specifically, the HBCUs give you a space to be you. When you go to a PWI, if you fail, or if you do something stupid, or you speak out of turn, or you miss an event, or you don't dress up–any little small mistake–it's looked at as, Oh, the Black guy, you know, messed up. The Black guy didn't dress appropriately. The Black guy didn't do this. And so you feel this whole weight of your race on you. Whereas at [the college], you don't feel that. If you mess up, no one is gonna say, Oh, well, all Black people mess up. And no one is gonna, like, attribute that . . . that one instance to your entire, like, lifespan or everyone else . . . all other Black males. They're not gonna use it to build a stereotype. So it just . . . It releases a lot of pressure and allows you to operate and kind of do whatever you want, um, and that's important. It's very important to be able to feel like you could be yourself. And a lot of times at PWIs, you cannot feel like you can be yourself. Um, so what does that do? Well, less pressure, obviously. You can focus on classes better. You can focus on, um, you know, development better. You know, being a part of, like, extracurricular organizations

> becomes easier; all these sorts of things just because, you know, you can feel like you can be yourself.

The young men also perceived that the HBCU provided many opportunities for internships, networking, and affiliation with other Black engineers. Dante believed that the school Dante attended, in particular, provided support systems and programming geared toward preparing Black engineers for the profession:

> HBCUs–[my school] in particular–does a much better job for any social, professional aspect than PWI. Networking? Much better than the average PWI. Presentation skills? Much better than the average PWI. Um, dress . . . Professional dress? Much better than the average PWI. And I don't mean that . . . Students themselves . . . You go by student . . . I mean you go by the approach that university uses to instill these particular values in their students. So I think [my school] has a culture there. The professors, the peers, the classes–everything tilts toward that regime where you learn how to present; you learn how to, um, network; you learn how to dress appropriately–even in engineering, which oftentimes is looked at as, They don't know how to dress. They don't know how to network, and they don't know how to present. And I think especially important to me was that every time I went somewhere–whether it was a conference or an interview or something like that–every time, remarked on how not a Black male was doing this, but how an engineer was able to present; how an engineer was able to command a room; how an engineer was able to not be socially awkward. I think [my school] does an amazing job and other HBCUs do an amazing job at that aspect–specifically for an engineering major.

The participants counted professional organizations, such as National Society of Black Engineers, and mentoring programs as critical factors supporting their academic achievement. Craig also noted that attending a HBCU provided the chance to come across Black male role models even when they were not directly involved as mentors:

> It goes back to what I said earlier about, you know, Black students or Black males not seeing people in those fields. You know, a lot of . . . Pretty much . . . Except for one friend, my main four friends or three friends–two of them went to University of Michigan and the other one went to Florida A&M–another HBCU. And uh, I can say . . . They used to tell me things like, Yeah, that doesn't . . . Either them or someone [would say], That doesn't represent the real world. You're in school with just Black people. The world is more than just Black people. I was like, Okay. But what it does, it's not just about going into the workforce. It's more than just Black people; we know that. But it's just about seeing those people; seeing African Americans in those roles who are engineers

> who are not just teaching classes, but they're also involved in research; and they're also presidents of the institutions, and presidents of their organizations. And that's . . . That can be inspiring and that can keep you going, you know? That can tell you that, Yeah, I can do this. I can be an engineer because, you know, Such-and-Such is a doctor. Such-and-Such else is a surgeon. Like, things like that, it inspires you and motivates you to keep going.

Word Frequency Query

Word counting may be used in qualitative content analysis to identify patterns in data and to contextualize codes (Hsieh & Shannon, 2005). Word counting allows for elucidation of the context associated with the use of the word or phrase (Hsieh & Shannon, 2005). Word counts are utilized to perform latent content analyses, which serve to aid in the process of interpretation of content (Hsieh & Shannon, 2005).

A word frequency query was performed using the NVivo software program. This was to identify the most frequently used words through the interview transcripts. The criteria for the query was set to include generalizations and to display the 60 most frequently used words with a minimum length of characters to avoid parts of speech, such as prepositions, pronouns, and conjunctions. The word, organizations, was the most frequently used word in the transcripts. Words that also appeared among the top 15 most frequently appearing words were group, activities, knowledge, parents, mentor, communal, equipping, academics, and friends.

The results of the word frequency query are displayed in three formats (see Appendices C, D, and E). The Summary (see Appendix C) displays the data yielded by the word frequency query in spreadsheet format sorted in descending order by count (the number of times that the word occurs within the project items searched, including similar words) and weighted percentage (the frequency of the word relative to the total words counted). The Word Cloud (see Appendix D) displays words in varying font sizes, where

the most frequently occurring words appear in larger fonts. The Cluster Analysis (see Appendix E) displays words as a horizontal dendrogram, where words that co-occur are clustered together.

Chapter 5: Discussion

The literature disclosed that African Americans males attend and complete college at a lower rate than African American females (Toldson et al., 2009). This circumstance has been attributed to a range of factors, including apathy toward education, demographic factors, and under preparedness in K-12 education (Thompson et al., 2006; Toldson et al., 2009). Along with lagging behind other ethnic groups in terms of general educational achievement, racial achievement gaps in STEM fields persist, with Blacks lagging behind their White and Asian counterparts and Black males lagging behind Black females (Harper, 2010; Moore, 2006).

Achievement in the STEM fields of study is a national imperative for the United States as STEM education is essential to economic development and competition in the global marketplace. The United States has a vested interest and escalating need to attract and retain underrepresented populations to the STEM fields of study and professions. African Americans males are members of underrepresented populations, especially in engineering fields; yet there is a dearth of literature that addresses this need (Moore, 2006). Furthermore, most studies, which included searches to provide insight to closing achievement gaps and narrowing attainment disparities in STEM, focus on student insufficiencies and shortfalls rather than achievement (Harper, 2010). Additionally, most studies published on the subject also concentrated on Black males enrolled in PWIs although enrollment in HBCUs represented 10.6% of total Black enrollment in Unites States universities as late as 2007 (Aud et al., 2010).

The research study addressed this gap in the literature by utilizing an anti-deficit achievement framework for research on students of color in STEM in a qualitative investigation seeking to uncover factors affecting success of undergraduate engineering

majors at a HBCU. Participants were all Black males who had graduated from an undergraduate program in the college of engineering at the same mid-Atlantic HBCU between 2012 and 2014.

Summary of Findings

Themes emerging from the study included definitions of success, precollege experiences, factors contributing to the informants' persistence during undergraduate study, and perceptions of attending a HBCU versus a PWI. These findings provided a wealth of data related to the research questions as detailed in chapter 4 and summarized in this section.

Research Question 1

Research Question 1 follows: How did precollege personal, academic, and social experiences of participants influence their pursuit of engineering majors? The participants stated their families and educational experiences have influenced their decision to attend college and engage in engineering study, expressing that high expectations, opportunities for exposure to math, science, and engineering concepts, and relationships with teachers' high school classes helped to prepare them as they entered undergraduate schooling.

Teachers who took the time to form personal relationships with their students were appreciated. The expectations of the parents were important to the informants. Even in cases where the parents could not directly relate to the college experience, encouragement of academic achievement and enrollment in readiness programs were attributed as having a positive effect on the part d the decision of the participants to pursue a degree in engineering. Precollege readiness programs in Detroit, Michigan; Cincinnati, Ohio; and Virginia were recalled in the participant' answers to the interview questions.

Research Question 2

The second research question follows: How do participants perceive their academic experiences at a HBCU compared with Black males in a predominantly White college of engineering? Each participant expressed that attending a HBCU as opposed to a PWI contributed to their ability to achieve academically and pursue their professional goals after graduation through the provision of preparation, a nurturing environment, and positive Black male role models as inspiration. Respondents felt "at home" and relieved of the pressure of being the only or one of a few Blacks in their class due to attending a HBCU. Their school was reported as paying special attention to preparing them for the professional world engineering in which they would be underrepresented. The school was credited with providing ample opportunities, internships, and job recruitment. Respondents also felt encouraged in seeing Black males in positions of leadership and authority. This fostered their motivation in facing challenges during the undergraduate years.

Research Question 3

Research Question 3 follows: How did established relationships with faculty and peers, and support and encouragement from these sources contribute to the persistence of participants? Mentors, professors, peer relationships, and personal resolve were factors reported as facilitating persistence to graduation in spite of the academic rigor associated with earning an engineering degree. Participants were especially grateful for mentors and cited mentors and mentoring relationships as being critical to their persistence to graduation. The young men fondly referred to professors who made an effort to form personal relationships with students and demonstrated that students' success was important to them. Informants expressed that relationships with peers within the college

of engineering and in in other areas of campus life were essential to their academic success and motivation earn their engineering degrees. Within the college of engineering, the National Society for Black Engineers was pointed out. Though study groups, friendships, and affiliations amongst engineering students were crucial for participants, they expressed that maintaining relationships and involvement in activities with nonengineering majors helped to break the possible monotony and rigor of the engineering course load.

Unusual Findings

Though not directly related to the research questions, participants expressed that their definition of success had changed over time from being rooted in financial prowess to being more altruistic in nature in addition to being measured in happiness. Participants also asserted that their families played a significant role in their persistence while in college. This was attributed to financial, emotional, and moral support, in addition to participants' feelings that they could not disappoint their families by failing to graduate.

Data from the interviews revealed that two of the four participants had decided to pursue long-term professional goals that were not directly related to engineering. These two participants were employed in the fields of finance and business management, respectively. Two participants had chosen to continue working in engineering beyond graduation. One was enrolled in a material science, philosophy doctoral program at the University of San Diego and the other was working as an engineer for a company in the Washington, District of Columbia, metropolitan area.

One participant mentioned that that individual would have participated in an additional college readiness program if the application had not required the participant's mother to disclose financial information. The participant believed that the participant felt

embarrassed to disclose how low a personal income actually was although the program was geared for low-income and first-generation potential college students. Though unrelated the questions, this finding would serve as useful information for developers and coordinators of income-based college readiness programs.

Interpretation of Findings

The study resulted in some findings that were anticipated by the researcher. These are the reasons Black males choose to engage in engineering study as undergraduates and what motivates them to persist to graduation. Family involvement and K-12 experiences given as factors supporting college achievement for Black males were expected outcomes; however, participants provided deeper insight regarding the ways in which these factors contributed to their success. Additionally, the study included a demonstration that Black males in engineering programs appreciate the learning environment provided by a HBCU. This was the desired direction of the study and participants provided thoughtful reasons as to what makes a HBCU a good place for Black males to pursue an engineering degree. Additionally, faculty and peer relationships were expected to be significant in contributing to the persistence of the respondents in reaching graduation; however, the findings provided a deeper scope into specific reasons why this is the case. The unusual findings from the study may provide direction for future research.

Context of Findings

The findings of the study converged with and extend the findings of existing literature. Convergence occurred with respect to assessment instruments and population characteristics. Additionally, data related to the role of an HBCU; the impact of college faculty, peer, and family relationships; and the significance of K-12 experiences with

regard to student success in higher education converged with and extended findings of previously published research.

Assessment instruments. This study utilized an assessment instrument that consisted of questions adopted from Palmer, Davis, and Maramba (2010) and from the anti-deficit framework published by Harper (2010). Many findings of the research study converged with findings in those studies, as well as the NBMCAS (Harper, 2010).

Population characteristics. In many previous studies, Black male college students were utilized as respondents. In some studies, the men were currently enrolled as students. In other studies, the men had attended PWIs or HBCUs respectively in varying degree programs. No previous study uncovered by the researcher looked at Black male engineering majors who had recently graduated from a HBCU.

The role of a HBCU. Previous research revealed that racial homogeneity at universities is viewed as having a positive impact on the success of Black students (Arroyo & Gasman, 2014; Palmer, Davis, & Maramba, 2010). These findings were in agreement with the research study and extended this finding to fit specifically with Black engineering students at a HBCU.

Faculty and peer relationships in college. Bonner's (2001) case study discussed the significance of peer and faculty relationships in college success for Black males. Bonner suggested that positive interactions with faculty inside the classroom and positive interaction with faculty outside of the classroom were important. Perhaps positive interaction with faculty outside of the classroom could serve to improve academic development for Black male student. Furthermore, development of deep relationships and broad perspective between faculty and students at the college level has been reported as making a positive difference for both parties. Goff-Crews (2014) found that faculty who

maintained transparency, held students to high standards, openly shared data, and built strong relationships with students made the most impact of students of color. The research study confirms that students view positive faculty interaction as being integral to academic success and extends the notion that interactions outside the classroom are equally crucial.

Organizations and programming. The impact of organizations and program participation during undergraduate years was a recurring and major theme in this study. This finding converged with those found in Fakayode, Yakubu, Adeyeye, Pollard, and Mohammed (2014) and Palmer, Davis, and Thompson (2010), which revealed that retention rates were better for STEM students who participated in programs that promoted teamwork, leadership, and critical thinking, in addition to providing opportunities to participate in enrichment, professional development, and social activities at HBCUs and PWIs respectively. Barker and Avery's (2012) suggested that programs geared toward Black males can serve a critical role in linking Black males to academic and social communities. Harper and Harris (2012) affirmed that student organizations can be an encouraging and supportive medium for helping Black men traverse the process of earning a degree.

Mentoring. Data gleaned from this study pointed to mentor and mentee relationships as having a significant impact of the success of participants during their undergraduate years as engineering majors. Tenenbaum, Anderson, Jett, and Yourick (2014) also found that mentorship relationships were beneficial for STEM learners.

K-12 experiences and influences. Previous studies had an emphasis on experiences in school before college as having an impact on the desire of Black males to pursue college and even further STEM education (Caboni &Adisu, 2004; Harper, 2010;

Rascoe & Atwater, 2005). The findings of this study were in agreement with existing literature regarding K-12 experiences and influences as they related to Black males and STEM education. This study also extended the research in its relevance to engineering majors specifically.

Family relationships. Herdon and Hirt (2004) and Smith and Hausafus (1998) made connections between family and success in college among Black students. Herndon and Hirt found that the foundation for college success laid in childhood and was cultivated throughout the different stages of the college career. Museus, Palmer, Davis, and Maramba (2011) also underscsored the impression of parental expectations and participation on success among racial and ethnic minority students in STEM in K-12 and higher education. These findings were in agreement with the findings of this study.

Implications of Findings

Theory. The findings of the research study were consistent with theories in the field. Researchers studied the reasons that Black males persist in college point to family, faculty, and peers. This also added the dimension of personal characteristics as they related to persistence in engineering majors.

Research. This study utilized Harper's (2010) "An Antideficit Achievement Framework for Research on Students of Color in STEM." Harper promoted inviting successful graduates to offer their insight by posing the anti-deficit as opposed to deficit-oriented questions, thus, inviting the respondents to recall factors that contributed to their success as opposed to identifying barriers. This study showed that it is useful in studying the experiences of Black males in STEM.

Practice. The findings viable resource for educational leaders and policymakers in their efforts to curb the trend of lagging African American male presence in

engineering scholarship and STEM achievement and improve retention. Education administrators at all levels of the educational pipeline beginning at the elementary level and leading through higher education could utilize these findings in the planning and design of readiness programs for students, teacher and professor preparation programs, formulation of mentoring groups, in-school and out-of-school activities for Black males, and family engagement and education activities.

Limitations

While there are advantages to utilizing the interview method of data collection, the advantages are counterbalanced by some limitations. According to Gall et al. (2007), two limitations are that "it is difficult to standardize the interview situation so that the interviewer does not influence the respondent to answer the questions a certain way" and volunteers will not be provided with anonymity (p. 229). Three of four interviews were conducted remotely via telephone. One interview was conducted in person. Because the study utilized respondents who had graduated from the university, most qualified participants no longer lived in the geographical area of the school so phone interviews were necessary. There was no way to guarantee anonymity for the participants; however, names have been changed in an effort to address this limitation.

Additionally, according to Gall et al. (2007), this study may have been limited due to the inability of the researcher to draw a sample from a sizeable and geographically dispersed population and "researchers have found that volunteer subjects are likely to be a biased sample of the targeted population" (p. 186). Internal validity of the study may also be threatened by the small number of research subjects and the possibility of dishonesty of informants when providing data (Shenton, 2004). Because the findings of this project were specific to a small number of individuals from a particular environment,

its external validity and generalizability may be limited.

Future Directions

Black males continue to lag behind their ethnic and gender counterparts in STEM achievement. Further research could investigate Black males who major in the other STEM areas of math, science, and technology. Additionally, future research could include a larger participant pool and students from additional universities with similar demographics. While Black male achievement is an imperative for the United States, research conducted in the fashion of the study could serve to shed light on ways to improve achievement for other minorities in STEM fields (Black women, Hispanics, Native-Americans).

The unusual findings of the study could serve as a springboard for further investigation. Two of the four respondents decided not to pursue engineering careers after graduation and a third was a graduate student in a nonengineering major. Further study could seek to identify the reasons that successful engineering graduates choose to leave the field and suggest approaches for retaining these individuals as engineering workers.

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Appendix A

Interview Protocol

Interview Protocol

1. What has life been like for you as a Black male?
2. How do you define success?
3. How has that definition of success changed overtime?
4. What are your long term professional goals?
5. What was the most significant experience of your undergraduate years?
6. When Black men do not achieve academic success in engineering majors, what are the primary factors you think make it difficult to achieve success?
7. What personal factors contribute to the success of Black men in engineering majors?
8. What role/impact did your parents/guardians have on your academic success?
9. How did your parents help shape your college and engineering career aspirations?
10. What did your parents do to nurture and sustain your math and science interests?
11. What educational factors contribute to the academic success of Black men in engineering areas?
12. What was it about certain K-12 teachers that inspired your math and science achievement?
13. How did you negotiate math and science achievement alongside popularity in school?
14. Who has played a significant role in your ability to become academically successful in engineering learning?
15. What role has mentoring played in your to be academically successful in engineering study?
16. Which out of school activities during your K-12 education contributed to the development of your interest in engineering?
17. Do you have any experience in precollege readiness programs?

18. If so, what aspects of the program(s) have you found most helpful?
19. What are factors promoting Black male achievement in engineering areas?
20. As you reflect on your college experience, what stands out as being critical to your ability to graduate with an engineering area degree?
21. What motivates you to do your best?
22. What information or insights would you share with other Black males entering college and enrolling in engineering degree programs to help them overcome barriers and achieve academically? How are these things different than what you would tell any student?
23. Which peer relationships and interactions do you deem most valuable to your achievement in engineering?
24. What would be the one thing you could not have succeeded without during your college years?
25. How do you feel attending a historically Black college and university as compared with a primarily White institution influenced you success as an engineering major?

Note. Questions from two articles were adapted and reprinted with the written permission of R. T. Palmer and S. R. Harper.

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Appendix B

Preinterview Informed Consent Forms

Preinterview Informed Consent Form

Title of study:
An Exploration of Factors Affecting Success of Undergraduate Engineering Majors at a

Principal investigator: Egheosa Igbinoba
Institute: Nova Southeastern University, Fischler School of Education and Human Services

Introduction:
I am Egheosa Igbinoba from the Fischler School of Education and Human Services, Nova Southeastern University and I am conducting research African American males and engineering education. I want to explore factors which lead to success as an undergraduate engineering major for African American males. Because you were a successful undergraduate engineering major, I would like to invite you to join this research study.

Background information:
Statistical data which shows that African American males consistently lag in higher educational attainment in STEM (Science, technology, Engineering, & Mathematics) majors when compared with their White counterparts. In an effort to narrow or close this gap of disparity, African American males need to be encouraged to major in the STEM curricula.

Purpose of this research study

This purpose of this case study is to explore critical factors associated with the success of Black males in engineering majors. It seeks to understand the perceptions of Black males as they relate to their own personal and academic experiences. This study aims to highlight the experiences before and during college that compelled the subjects to excel as engineering students. The themes and factors related to policies, programs, resources and people that contributed to these men persisting and earning degrees in engineering majors discovered in the study may be utilized in the formulation of interventions to address the problem of relatively low numbers of these students earning such degrees.

Procedures
In this study I will ask 25 questions about your experiences before and during your undergraduate studies. This will take about 1 hour of your time. The interview will be recorded using a digital audio recording device.

Possible risks or benefits
There is no risk involved in this study except your valuable time. There is no direct benefit to you also. However, the results of the study may help us to formulate guidelines for teaching and training potential African American male students in STEM areas.

Right of refusal to participate and withdrawal
You are free to choose to participate in the study.

Confidentiality
Your name and identity will also not be disclosed at any time unless you give consent. The data may be seen by a review committee and may be published in journal and elsewhere without giving your name or disclosing your identity.

Available Sources of Information
If you have any further questions you may contact Egheosa Igbinoba on following phone number 305-785-2367.

1. AUTHORIZATION

I have read and understand this consent form, and I volunteer to participate in this research study. I understand that I will receive a copy of this form. I voluntarily choose to participate. I further understand that nothing in this consent form is intended to replace any applicable Federal, state, or local laws.

_____
Participant's Name (Printed):

Date:_____

_____
Participant's Signature:

Date:_____

_____
Principal Investigator's Signature:

Date:_____

Appendix C

Summary Spreadsheet of Word Frequency

Results of Word Frequency Query - page 1

Word	Length	Count	Weighted percentage (%)	Similar Words
organizations	13	458	1.33	academy, administratively, adult, african, american, arranged, artist, asian, assistant, better, black, brave, candidate, classmate, closer, college, combination, committee, company, computer, conference, connection, corporate, council, ensemble, executive, familiar, female, fraternity, friend, friendly, great, guardian, hierarchy, household, independent, industry, junior, majors, manage, master, mentor, military, nation, national, office, official, opposite, organizations, organized, owner, parent, police, population, professional, regime, regular, researcher, scientist, senior, simple, society, strings, stupid, suicide, talent, university, veteran, white, worker, workforce, young
personal	8	430	1.25	activist, adult, african, ambassador, american, artist, asian, assistant, bachelor, better, black, blood, brave, calvin, candidate, classmate, closer, company, computer, connection, electrician, executive, familiar, female, friend, general, graduate, great, guardian, independent, james, johnson, junior, lawyer, major, mason, master, mentor, musician, national, official, opposite, owner, personal, personality, personally, persons, president, professional, regular, researcher, scientist, senior, simple, speaker, stupid, suicide, talent, valedictorian, veteran, white, worker, worth, young
classes	7	120	0.71	academia, category, classes, conference, courses, families, fraternity, future, grades, group, orientation, separates, society, sorts, stereotype
changing	8	305	0.67	appreciation, benefit, better, black, blind, brush, bunch, changed, changing, combination, coming, complexion, connection, culture, descent, difference, discipline, diversify, enjoy, entry, equip, graduate, instill, level, lower, outpouring, phenomenon, provide, right, spread, still, teach, truss, weight, white
attributes	10	199	0.65	ability, advantage, aspect, attitude, attributes, ballgame, benefit, better, complex, complexion, connection, decision, degree, difference, discipline, diversity, emotion, energy, happiness, large, level, merit, might, nature, office, passion, personality, perspective, preparedness, reality, regular, sentiment, status, terms, trait, triangle, unemployment, upbringing, utility, weight, welfare, worth
students	8	102	0.61	calvin, graduate, james, major, master, senior, students, undergrad, undergraduate, valedictorian
group	5	192	0.60	audience, blind, blood, brave, brush, bunch, category, college, combination, company, complexion, culture, drove, english, enrollment, ensemble, fraternity, group, groups, hierarchy, information, nation, network, population, society, sorts, timid, unemployed, university, young
activities	10	131	0.59	activist, activities, alive, architecture, boring, collar, counting, coursework, designing, discipline, drafting, encouragement, energy, excited, graduation, grasp, hanging, hearing, internship, involved, keeping, looking, michigan, nursing, office, orientation, pageant, paperwork, perseverance, presentation, profession, realization, repeating, scheduling, schooling, sweat, tears, third, trait, treated, using, utility, workload

Results of Word Frequency Query - page 2

Word	Length	Count	Weighted percentage (%)	Similar Words
knowledge	9	246	0.54	ability, attitude, culture, discipline, excuse, general, history, information, knowing, knowledge, learning, level, mentality, mindset, normal, orientation, passion, perspective, problem, reality, recognition, scholarship, science, sense, sentiment, standpoint, stereotype, understanding, values
parents	7	48	0.53	parent, parental, parents, raised
mentor	6	75	0.50	learn, mentor, mentoring, mentors, teach
communal	8	230	0.45	advice, common, communal, connection, conversation, counseling, discipline, encouragement, entry, exact, excuse, group, honor, information, interview, james, johnson, learn, lesson, level, lower, marker, mason, mentor, moral, network, outpouring, presentation, recognition, reward, sense, showing, speak, speaker, speaking, spout, street, symbol, teach, trait, understanding, video, white, young
equipping	9	163	0.44	basketball, black, collar, equip, equipped, equipping, football, prepared, provide, still, weight, white
academics	9	55	0.42	academia, academic, academically, academics, professor
friends	7	65	0.40	classmate, connection, familiar, friend, friendly, friends, informal, social, supported, supportive
mentees	7	33	0.39	mentee, mentees
males	5	43	0.38	bachelor, entire, junior, males
professors	10	50	0.37	academic, professor, professors
schools	7	32	0.35	academy, schooling, schools
complex	7	124	0.34	college, complex, factory, involved, refinery, still, whole
graduated	9	35	0.30	graduate, graduated, graduating, graduation
engineers	9	42	0.29	discipline, engineers, organizations, organized, profession
difficult	9	54	0.28	ambitious, awkward, challenging, difficult, trying
whole	5	87	0.28	altogether, backing, calculus, completed, completely, complex, connection, entire, future, hanging, level, marker, master, nature, network, parent, route, spout, triangle, utility, weight, whole
helped	6	68	0.28	aided, appreciation, assistant, available, backing, benefit, better, encouragement, helped, helpful, helping, provide, reward, supported, supportive, utility, worker
discipline	10	107	0.28	architecture, conditions, discipline, disciplined, english, history, humanities, major, science, studied, studies, studying, tactics, trait
figures	7	33	0.28	couple, figures, grasp, images, seven, three, triangle
everyone	8	23	0.28	everyone
teachers	8	27	0.28	teacher, teachers
appropriately	13	45	0.27	appropriately, money, right
black	5	105	0.26	black, blacks
concepts	8	70	0.26	aspect, category, complex, concepts, designing, given, right, teacher, whole
scholarship	11	54	0.25	learn, learned, learning, scholarship, scholarships

Results of Word Frequency Query - page 3

Word	Length	Count	Weighted percentage (%)	Similar Words
institutions	12	91	0.25	academy, college, company, institutions, kindergarten, university, utility
knowing	7	117	0.24	appreciation, couple, experiences, experiments, grasp, knowing, knowledge, learn, learned, learning, master, orientation, realization, recognition, sense, understanding
grades	6	66	0.24	degree, energy, grades, level, places, plethora
successful	10	34	0.24	great, succeed, successful, welfare
professional	12	69	0.22	academic, adult, lawyer, master, professional, professionally, professionals, professor, teacher, white
looking	7	56	0.22	aspect, aspects, attends, counting, depends, expectations, expected, expecting, looked, looking, seeing, seemed, seems
science	7	68	0.22	ability, algebra, calculus, discipline, finance, science, skills
ability	7	104	0.22	ability, grasp, knowledge, mentality, science, sense, talent, understanding
trying	6	47	0.22	difficult, hearing, proved, tried, trying
others	6	23	0.21	another, difference, opposite, others, separates
challenging	11	37	0.20	ambitious, challenges, challenging, competitive, difficult
college	7	76	0.20	college, colleges, complex
prepared	8	73	0.19	developing, discipline, equipped, homework, learn, organizations, organized, prepared, preparedness, preparing, provide, scheduling, schooling, spread, teach, willing
supported	9	50	0.19	affirmative, affirmed, appreciation, backing, based, excuse, hanging, keeping, provide, reward, stands, supported, supportive, truss
cultural	8	38	0.18	appreciation, attitude, cultural, culturally, culture, cultures, growing, social, society
information	11	103	0.18	common, conversation, excuse, familiar, friendly, general, informal, information, instill, knowing, knowledge, learn, mentor, presentation, reward, speaker, spread, teach
undergraduate	13	40	0.18	junior, senior, sophomore, undergrad, undergrads, undergraduate
positive	8	60	0.18	affirmative, aligns, attitude, bishop, complexion, fifth, formal, fourth, level, orientation, positions, positive, scenario, situations, south, standpoint, status, terms, third
throughout	10	15	0.18	throughout
human	5	66	0.18	architecture, discipline, english, group, history, human, humanities
amazing	7	16	0.18	amazing, sticking
adult	5	70	0.17	academic, adult, bachelor, granny, lawyer, personality, professional, senior, teacher, white
understand	10	91	0.17	appreciation, clearly, grasp, knowing, realization, realized, recognition, seeing, sense, understand, understanding
programs	8	25	0.17	information, programs, regime, schedules, scheduling, tactics, utility
interactions	12	90	0.17	brush, bunch, company, group, interactions, learn, level, lower, network, speak, spout, teach
connections	11	35	0.16	associates, connecting, connection, connections, continues, couple, friend, instill
interested	10	58	0.16	benefit, curious, interested, interesting, interests, involved, right, welfare, worries

Appendix D

Word Cloud

Word Cloud


information
successfulsupported
programs
appropriately
professional
professors
mentor
parents
trying
challenging
scholarship
concepts
knowledge
communal
everyone
looking
amazing
adult
understand
teachers
changing
schools
helped
figures
difficult
classes
engineers
graduated
mentees
human
organizations
prepared
connections
grades
group
friends
complex
academics
whole
black
ability
positive
interactions
equipping
discipline
knowing
science
college
interested
attributes
personal
students
activities
males
institutions
throughout
others
undergraduate
cultural

Appendix E

Results of Cluster Analysis

Results of Cluster Analysis